

# Semi-Autonomous Telerobotic Manipulation for On-Orbit Spacecraft Servicing and Assembly over Time-Delayed Telemetry

Completed Technology Project (2012 - 2016)



## Project Introduction

Despite the prevalence of this telerobotic surgery of humans, we still do not have the capability to service (refuel and repair) or assemble spacecraft on-orbit with telerobotic systems. Whether we intend to service active spacecraft on-orbit, or assemble new larger spacecraft on-orbit, the ability to do so with telerobotic systems could yield a new paradigm for spacecraft development and design. This would remove the constraints imposed on spacecraft designs by launch vehicles and enable the development of larger and previously-impossible space structures. Developing sufficiently capable and robust telerobotic systems for on-orbit operations is a technological challenge that and will require novel methods in order to yield a practical solution. My proposed research will begin with the augmentation of classical telerobotic systems with algorithms and approaches normally used in autonomous robotics. I will draw on my own research experience and familiarity in both of these subfields of robotics in order to develop new fundamental research in semi-autonomous telerobotics. My research plan includes: (1) incorporating more sophisticated sensing and motion-planning into telerobots, (2) developing algorithms and systems for multi-scale autonomy, and (3) using machine-learning to feed telerobotic experience back into the semi-autonomous systems. I believe we can develop a new class of robust semi-autonomous robotic platforms that will enable us to perform far more complex tasks than we could previously with telerobotic systems under high-latency telemetry.

## Anticipated Benefits

Whether we intend to service active spacecraft on-orbit, or assemble new larger spacecraft on-orbit, the ability to do so with telerobotic systems could yield a new paradigm for spacecraft development and design.



Project Image Semi-Autonomous Telerobotic Manipulation for On-Orbit Spacecraft Servicing and Assembly over Time-Delayed Telemetry

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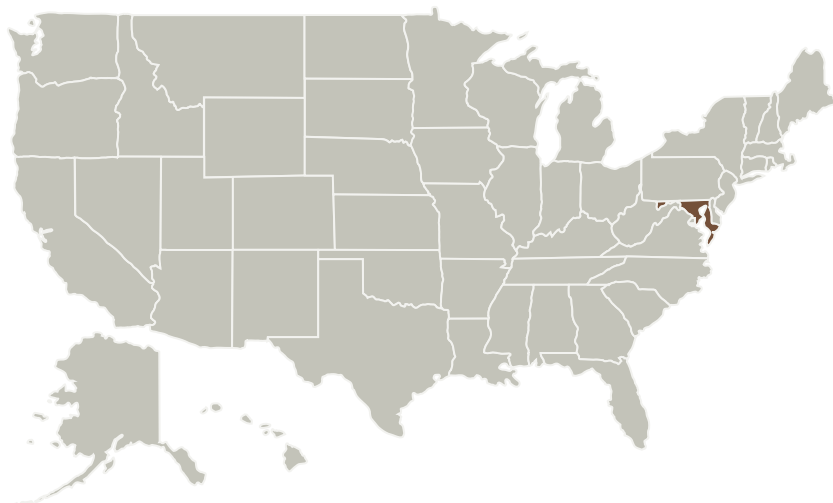
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## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role                    | Type     | Location            |
|-------------------------------|-------------------------|----------|---------------------|
| Johns Hopkins University      | Supporting Organization | Academia | Baltimore, Maryland |

## Primary U.S. Work Locations

Maryland

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Responsible Program:**

Space Technology Research Grants

## Project Management

**Program Director:**

Claudia M Meyer

**Program Manager:**

Hung D Nguyen

**Principal Investigator:**

Louis Whitcomb

**Co-Investigator:**

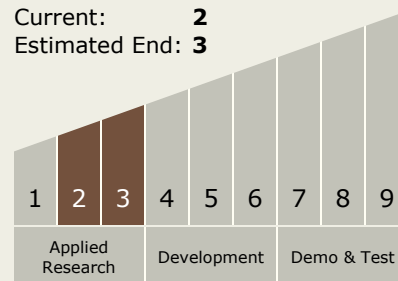
Jonathan R Bohren

## Technology Maturity (TRL)

Start: 2

Current: 2

Estimated End: 3



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## Images



**11482-1363264677333.jpg**

Project Image Semi-Autonomous  
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(<https://techport.nasa.gov/image/1821>)

## Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>

## Technology Areas

### Primary:

- TX04 Robotic Systems
  - └ TX04.4 Human-Robot Interaction
    - └ TX04.4.3 Remote Interaction